

by high northeast to northwest winds on the Atlantic coast. It was last seen at 4:35 p. m., of the 23rd, east of Cape Breton, moving rapidly northeast.

No. XIII.—The moderate norther that followed low barometer No. XII seems to have been in great part induced by the low pressure prevailing from Texas to California on the 22nd, and to have given rise to the area of rain and subsequent low pressure, No. XIII, which was central on the western border of Texas at 4:35 p. m. of the 23rd. The barometric depression of the 22nd was evidently one of many similar cases in which an area of low barometer, existing upon the Pacific coast of Mexico, is transferred to the eastern slope of the Cordilleras precisely as occurs frequently along the coast from Alaska to Oregon. In both regions the consequences are similar—namely, a strong flow of air westward up the slope of the Rocky Mountains and the formation of areas of cloud, rain and snow with new centres of low pressure. The course pursued by No. XIII was slowly eastward along the Gulf coast to northern Florida, over which it disappeared 4:35 p. m. of the 25th, having been accompanied by heavy rains throughout the Gulf and South Atlantic States, and followed by a severe norther over the Western Gulf coast.

No. XIV.—This area seems to have originated in western Texas under conditions very similar to those attending the formation of No. XIII. It was central near the Texas coast at 11 p. m. of 22nd, whence it moved slowly eastward to the mouth of the Miss., and then turned to the northeastward through Ala. and W. Virg. into eastern New York, where it was central at 11 p. m. of the 29th. The central low barometer had steadily and rapidly fallen from 29.80, at 11 p. m. of the 27th, and 29.65, at 11 p. m. of the 28th, to 28.85, at 11 p. m. of the 29th. At which time, also, the area of snow and rain, with high winds or gales, covered the Lower Lakes, Middle and Eastern States, making this one of the severe storms of a very stormy month. The depression continued its course northeastward on the 30th, and was, at midnight, central over the Gulf of St. Lawrence.

No. XV.—While No. XIV was, during the evening of December 30th, passing over New Brunswick, and the highest pressure was central in the Eastern Gulf States, a third depression, No. XV, was developing in western Texas or northern Mexico, in consequence of the precipitation of moisture that had been carried by easterly winds up the slope of the Rocky Mountains. This depression was central at midnight of the 30th west of Indianola, but at 7:35 a. m. of the 31st was as a violent storm, central between Indianola and Galveston. It moved eastward during the rest of the 31st, with increasing severity, and was on the morning of January 1st, 1877, central in Georgia, while northerly gales prevailed in the Western Gulf. The track of this memorable storm, during the 1st and 2nd of January, is shown on chart No. I, but its further history belongs to the REVIEW for that month.

Storms at Sea have been reported by numerous vessels, among them as follows: on the 1st heavy NW. gales off Cape Horn, also in lat. 44° N., long. 40° W.; hurricane in 37° N., 16° W.; on the 1st and 2nd, NW. gale off Cape Hatteras; on the 4th, heavy NW. gale, 30° N., 70° W., hurricane near the Orkney Islands; on the 7th, storm near Cape May; on the 8th, heavy W. gale off Cape Hatteras; on the 9th, furious NW. gale prevailed along the Middle and East Atlantic coast, increasing to a hurricane force in some localities; this gale was felt at sea as follows: on the Western Bank, also at 40° 15' N., 67° W., at 43° N., 64° W., (a hurricane, bar. 28.80, at 42° N., 61° W., at 40° N., 70° W.; on the 10th the gale of the preceding day continued with high sea, being reported from 41° 44' N., 59° W., 41° N., 56° W., 36° N., 70° W., and 40° N., 70° W.; on the 12th, a terrific gale in the Prince Edwards Islands; 13th, gale with high sea, 41° N., 62° W.; 14th, gale with high sea, 49° N., 37° W.; 15th, heavy gale and very high sea, 48° N., 37° W., also 41° N., 72° W.; 16th, heavy N. E. gale veering to NW. on the Middle and East Atlantic coast; at St. John, N. B., the storm of the 16th and 17th was the severest of the season; wind gusts of 50 miles and heavy snow with great fall in temperature were reported; 18th, heavy gale and high sea, 46° N., 48° W.; 19th, heavy gale, 45° N., 53° W.; hurricane 34° N., 74° W., also a gale 34° N., 43° W., also heavy NW. gale off the Middle Atlantic coast; 24th, heavy NW. gale, 34° N., 74° W.; 26th, heavy NW. gale, 48° 17' N., 34° 50' W., also at 47° 31' N., 37° 30' W.; 29th, NE. gale veering to SW., 26° N., 71° W., also a heavy NE. gale veering to SW., and at times blowing with hurricane force 20 miles SE. of Abesecom, a cyclone was encountered between New York and Bermuda by the Bark Elila Brass; 30th, heavy SW. gale off Cape Fear river bar; 31st, heavy NE. gale and snow storm off the New Jersey coast.

TEMPERATURE OF THE AIR.

In General.—The general distribution of the temperature for the month is shown by the isotherms on Chart No. II. From which it appears that the temperatures have on the Pacific coast, been somewhat above the average. At the stations in the Rocky Mountains the deviations were: Salt Lake City, 3°; Cheyenne, 3°.9; Denver, 1°.7; Santa Fe, 2° 0; all below the average. East of the Rocky Mountains, and for altitudes less than 5,000 feet, the temperatures every where have been much below the average.

The Maximum Temperatures above 70° have been as follows: Corsicana, 72; Denison, 72; Galveston, 70; Indianola, 75; Jacksonville, 71; Key West, 87; Montgomery, 70; New Orleans, 72; San Diego, 77; Shreveport, 70; Berne, Texas, 71; and the maxima lower than 40° have been at Alpena, 38; Duluth, 39; Escanaba, 36; Marquette, 37; Pembina, 35; Pike's Peak, 27; Port Huron, 40. The maximum tem-

peratures for the month generally occurred from the 11th to the 14th, at most of the stations east of the Rocky Mountains, during the movement of storms No. IV, V, VI and VII.

Minimum Temperatures below -20° are as follows: Bismarck, -23° ; Breckenridge, -23° ; Denver, -25° ; Duluth, -30° ; Fort Sully, -26° ; La Crosse, -24° ; North Platte, -25° ; Pembina, -49° ; Pike's Peak, -21° ; St. Paul, -27° . The minimum above $+20^{\circ}$ have been Charleston, 23; Galveston, 26; Indianola, 23; Jacksonville, 24; Key West, 45; Mobile, 21; New Orleans, 28; Portland, Or., 24; San Diego, 43; San Francisco, 42; Savannah 20 and Tybee Island 25. The minimum temperatures have attended the progress of areas of high pressure and clear, dry weather, as given in the previous chapter. The principal epochs of low temperature have been as follows: 1st in Fla.; 2nd, Ga., S. C. and Fla.; 3rd, Fla.; 4th, Fla.; 6th, Ga., Fla.; 7th and 8th, Dak., Mo.; 9th, Ill., Ohio, Iowa, Minn., Ind., Tenn., Wis., Ky.; 10th, N. J., Md., N. C., Ohio, Mich., Pa., Va., W. Va., N. Y., D. C.; 11th, Cal.; 14th, Utah; 15th, Cal.; 16th, Mich., N. Y., Minn., Or.; 17th, N. Y., Mich., Mass., Vt., N. J., Me., Conn., R. I., Cal.; 18th, Utah, Cal.; 23rd, Cal., Montana, Tex.; 24th, Wy. T., Col., N. M.; 25th, N. Y., Wy. T., Tex., Mass.; 26th, Dak., Kan., Neb.; 27th, Dak.; 28th, Col.; 29th, Dak., Tex., Kan., Neb.; 30th, Minn., Ill., Dak., Ind. T., Tenn., Ga., Ala., Miss., La., Neb.; 31st, Tenn.

Ranges of Temperature—The largest ranges of temperatures for the month have been: Denver, 93° ; North Platte, 87° ; Dodge City and Pembina, 84° ; Fort Sully, 82° ; Fort Gibson, 77° ; Breckenridge, 75° ; Yankton, 72° ; Leavenworth and Duluth, 69° ; St. Paul, 68° ; Bismarck, Denison, Keokuk, La Crosse and Virginia City, 67° . The smallest ranges have been: San Francisco, 22° ; Portland, Or. and Salt Lake City, 32° ; San Diego, 34° ; Tybee Island, 38° ; Buffalo, Charleston, Key West and New Orleans, 42° ; Cape Lookout, Sandy Hook and Smithville, 43° ; Atlantic City, Barnegat and Galveston, 44° .

Frosts have occurred as far southward as the Gulf States in every day of the month except the following: 8th, 11th, 14th, 21st, 22nd, 23rd and 24th. The first period of cold, which continued from the 1st to the 6th, is especially reported on by the Observer at Pania Rassa, according to whom, at that place, scarcely anything escaped being injured by the cold. Large quantities of fish, of all sizes and kinds, were killed by the cold water, and cast up on the beach daily. Snow fell for about five minutes on the morning of the 1st. Within a region of fifty miles radius frost occurred nearly every day.

PRECIPITATION.

In General—The distribution of the total amount of rain or melted snow for December is shown upon chart No. III. The great irregularity in snow-fall and its drifting by the wind, as well as the want of uniformity in methods of measuring the dry and the melted snow render the isohyetal lines, open to some doubt; but, in general, it appears that less than an inch fell in Minn., Iowa, Ill., and westward to the Rocky Mountains, producing a large deficiency in this region as compared with normal values. The deficiency is also quite decided in the Ohio valley and Tennessee and for the Middle Atlantic States. A small deficiency is reported from the Upper and Lower Lake regions, Minnesota, New England and the Western Gulf States, but a large excess has fallen in the Eastern Gulf and South Atlantic States. The deficiency in New England and the Middle Atlantic States was to a large extent made up for by the storm of January 1st, 1877. The most remarkable feature of the map is the remarkable deficiency in Or. and Cal. The normal values for these regions are approximately as follows: San Diego, 2 inches, San Francisco, 5 inches and Portland, Or., 7 inches. These notable deficiencies are to be taken in connection with the high temperature and the high barometric pressures that have also prevailed there.

Stations reporting no rain during month.—No rain at all is reported from four stations in the immediate neighborhood of San Francisco, Cal., as also from Ft. Clarke, on the Rio Grande, Texas. Numerous stations report one-tenth inch of rain, or less, near the boundary between Kansas and Nebraska.

Stations reporting heavy rains or snow are as follows: Cape Lookout, 6.15; Jacksonville, 6.15; Mobile, 7.18; New Orleans, 9.57; St. Marks, 8.51; Eaton Rouge, 2 inches of rain fell from noon to 10 p. m. of the 31st. Heavy snows were reported as follows: Monticello, Ark., 28th, 7 inches; 31st, 21 inches; Lenore, N. C., 24th and 25th, 11 inches; Spartanburg, S. C., 23rd, 24th and 25th, 10 inches; McMinville, Tenn., 28th and 29th, 14 inches, heaviest snow ever known; Raleigh, N. C., 25th, 13 inches, heaviest snow storm ever known in that vicinity; Memphis, Tenn., 28th, 8½ inches; Shelbyville, Tenn., 28th, the heaviest snow-fall since the 15th and 16th of May, 1843, when the fall was 21 inches, and very uniform. The observer at Hwassie College, Tenn., reports that the snow-fall of December 31st and January 1st amounted, in 17 hours, to 20 inches, being the most remarkable snow-fall known to the inhabitants.

Total snow-fall for month.—Ark., 12 to 28 inches; Conn., 11 to 38; Cal., 4; Dakota, 5; Del., 4½; Ga., 1; Ill., 2 to 26; Ind., 3 to 24; Iowa, 2 to 8; Kan., 1 to 7; Ky., 10 to 14; La., 12; Maine, 32 to 43; Md., 8 to 15; Mass., 12 to 36; Mich., 15 to 24; Mo., 1 to 4; Neb., 1 to 5½; N. H., 39 to 42; N. J., 6 to 18; N. Y., 7 to 10; N. C., 6 to 26; Ohio, 8 to 42; Penn., 4 to 28; R. I., 18; Tenn., 17 to 29; Tex., 8; Utah, 10; Vt., 18 to 55; Va., 4 to 18; W. Va., 28; Wis., 3 to 21.